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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/876,955	06/07/2001	Shirley Hemar	005329	4359
32588	7590	12/13/2005	USA/MASK/RT/OR	
APPLIED MATERIALS, INC. 2881 SCOTT BLVD. M/S 2061 SANTA CLARA, CA 95050			EXAMINER STREGE, JOHN B	
			ART UNIT 2625	PAPER NUMBER

DATE MAILED: 12/13/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/876,955

Applicant(s)

HEMAR ET AL

Examiner

John B. Strege

Art Unit

2625

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 October 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-34 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 07 June 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 10/24/05.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

Response to Amendment

1. The amendment received 10/24/05 has been entered in full.

Response to Arguments

2. Applicant's arguments with respect to claim 1-34 have been considered but are moot in view of the new ground(s) of rejection.

Terminal Disclaimer

3. The terminal disclaimer filed on 10/24/05 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of USPN 6,268,093 has been reviewed and is accepted. The terminal disclaimer has been recorded.

DETAILED ACTION

Claim Rejections – 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-2, 5-6, 9, 11-16, 19, and 21-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ferguson et al. USPN 6,327,033 (hereinafter "Ferguson") in view of Kuwabara USPN 6,580,502, and further in view of Ferguson et al. *Application of*

an Aerial Image Measurement System to Mask Fabrication and Analysis (as cited in the IDS, hereinafter referred to as "AIMS").

The following is in regard to claim 11. Ferguson discloses a method and apparatus for detecting phase defects and other phase features on a photomask using differential imaging (col. 1 lines 5-10). Ferguson recites that a phase shift mask which may contain phase defects or features is illuminated by light at the inspection wavelength and the transmitted (or reflected) image of the mask is measured by an optical lens or objective at two focus positions in a positive and negative direction (col. 6 lines 20-30). In scanning the mask the images may be collected concurrently or sequentially in any order (col. 6 lines 33-39). Making a differential image compares the images obtained from the two separate images, in order that the variations may be detected (col. 6 line 63 – col. 7 line 3). Furthermore Ferguson discloses in figure 11 that the images can be obtained in a single pass. In this embodiment two light sources are disclosed (721 and 722) that are used to transmit illumination to the mask. Although Ferguson discloses that the images may be concurrently produced (col. 6 lines 36-39) it is not explicitly disclosed that are concurrently produced from the same light transmitted by the mask. Furthermore Ferguson discloses that the images of the mask can be the reflected image of the mask (thus of the actual mask itself) or the transmitted image of the mask (col. 6 lines 24-25). Ferguson does not explicitly disclose that aerial imaging is possible, however it is apparent that since the image can be transmitted then it would also work with an aerial imaging system.

Kuwabara discloses an appearance inspection method which simultaneously acquires two images on different focal planes, and uses the images for comparative inspection (col. 3 lines 34-37). As can be seen in figure 1 a broad band light source 15 transmits light to the substrate 13, and images of different focal lengths from the same light transmitted by the mask are captured simultaneously by the cameras 23, and 24.

AIMS (written by Ferguson) discloses using an Aerial Image Measurement system with phase-shift mask fabrication (see at least the abstract). AIMS discloses that the AIMS tool can be used to automate the extraction of transmission, phase, and second-level overlay for phase-shifting processes such as PSM (see at least the abstract). AIMS states that the advantage of using an Aerial Image Measuring System is that lithographers can save time and reduce expenses through evaluations of lithographic behavior for a variety of reticle configurations without engaging expensive equipment or personnel in the fabrication line. It would have been obvious to one of ordinary skill in the art to combine Ferguson and AIMS, since Ferguson says that his system can be used for transmitted images, and AIMS discloses the advantages of using an Aerial Imaging System.

Ferguson and Kuwabara are analogous art because they are from the same field of endeavor of inspection using image processing at different focuses, and Ferguson and AIMS are analogous art because they are from the same field of endeavor of PSM inspection.

At the time of the invention it would have been obvious to one of ordinary skill in the art to combine Ferguson, Kuwabara, and AIMS to concurrently produce the aerial

images from the same light transmitted by the mask. The motivation for doing so is that using one light source would make the invention cheaper and more compact. Thus it would have been obvious to one of ordinary skill in the art at the time of the invention to combine Ferguson, Kuwabara, and AIMS to obtain the invention as specified in claim 11.

Claim 1 has the same limitations as claim 11, however claim 1 is a method claim. As discussed above Ferguson discloses a method and apparatus. Therefore the same arguments discussed above apply equally to the rejection of claim 1.

Regarding claims 2 and 12, as discussed above Ferguson discloses a positive out of focus condition and a negative out of focus condition.

Regarding claim 5, Ferguson discloses that in order to ensure defect free masks following fabrication, the mask manufacturer will perform an automated optical inspection of the reticle to search for unwanted defects on the mask by comparing images of the mask from the optical inspection system (col. 2 lines 44-52).

Regarding claim 6, the differential image 780 (figures 10 and 11) can be considered a map of the variations in phase by using results of the comparison.

Regarding claims 9 and 19, Ferguson discloses that the mask to be inspected for phase defects (700) is secured to the moveable stage of the inspection system (710).

Regarding claims 13-14, two inspection optics units are shown in figure 11 (731 and 732).

Regarding claim 15, this limitation has already been addressed above.

Regarding claim 16, figure 11 discloses an illumination source 721.

Regarding claim 21, figure 11 shows an illumination source 721 and inspection optics units (731 and 732) for collecting light emerging from said phase shift mask.

Regarding claim 22, AIMS discloses that the Aerial Image Measurement System comprises a numerical aperture diaphragm for reproducing said set of exposure conditions (first paragraph of section 2, page 132 discloses that the numerical aperture can be adjusted).

6. Claims 3-4,7-8,10,17-18,20, and 23-24,27,29-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ferguson et al. USPN 6,327,033 in view of Kuwabara USPN 6,580,502 in view of Ferguson et al. *Application of an Aerial Image Measurement System to Mask Fabrication and Analysis* (as cited in the IDS, hereinafter referred to as "AIMS") and further in view of Shiraishi et al. USPN 5,576,829 (hereinafter "Shiraishi").

Claim 23 is similar to claim 11, except it has the additional limitations of a light source, a transmission light illumination means, and the optical means for producing a plurality of magnified aerial images of the phase shift mask under a set of exposure conditions, said optical means having a numerical aperture diaphragm. AIMS discloses that the Aerial Image Measurement System comprises a numerical aperture diaphragm for reproducing said set of exposure conditions (first paragraph of section 2, page 132). As the other limitations have already been discussed above as being disclosed by Ferguson and Kuwabara, only these new limitations will be addressed here.

Ferguson discloses a light source (722 of figure 11) and a transmission illumination means 721 for illuminating the mask. AIMS discloses that the Aerial Image Measurement System comprises a numerical aperture diaphragm for reproducing said set of exposure conditions (first paragraph of section 2, page 132 discloses that the numerical aperture can be adjusted).

As discussed AIMS also discloses an optical means for producing aerial images, however it is not explicitly disclosed that the aerial images are magnified.

Shiraishi discloses a system for inspecting a phase-shifted mask where the amount of phase shift is determined in accordance with the light quantity ratio between the images of phase-shier of the inspection pattern in a defocus condition (as stated at least in the abstract). Shiraishi discloses that while the magnification of the inspection optical system 13a, 13b may be selected as desired, the measurement of the light quantity distribution is easy if the pattern 11a to 11c on the reticle 10 is magnified over the detector 16. In this case, instead of moving the reticle 10 in the direction of the optical axis AX of the inspection optical system 13a, 13b, the detector 16 may be advantageously moved since the accuracy of position setting becomes less severe by an amount corresponding to the square of the magnification.

Ferguson, Kuwabara, AIMS, and Shiraishi are analogous art because they are from the same field of endeavor of phase-shift mask inspection.

At the time of the invention it would have been obvious to one of ordinary skill in the art to combine Ferguson, Kuwabara, and Shiraishi in order to obtain magnified images. The motivation for doing so is that the detector can also be moved easily

instead of the reticle. The motivation for this is provided above. Thus at the time of the invention it would have been obvious to one of ordinary skill in the art to combine Ferguson and Shiraishi in order to obtain the invention as specified in claim 23.

Claim 24 has the same limitation as claim 12 which as stated is provided for by Ferguson. The same situation applies for the following claims where there limitations have been discussed above as being disclosed by Ferguson.

Claim 27 is similar to claim 9 rejected above.

Claim 29-31 are similar to claims 14-15 rejected above.

Regarding claim 32, Ferguson discloses a post processing and review means for displaying condition of the phase shift mask as seen in figure 9.

Regarding claim 33, Ferguson discloses the defect inspection step has an inspection wavelength that is the same as the exposure wavelength (col. 2 lines 55-57).

Regarding claim 3, Shiraishi discloses that the images are passed through a Fourier transform plane which would simulate the behavior of an exposure system.

Claim 4 is similar to limitation presented in claim 23, thus the combination of Ferguson and Shiraishi applies as well.

Claims 7-8, and 17-18 are similar to claims 25-26.

Claims 10 and 20 are similar to claim 9.

7. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ferguson et al. USPN 6,327,033 in view of Kuwabara USPN 6,580,502 in view of Ferguson et al. *Application of an Aerial Image Measurement System to Mask*

Fabrication and Analysis (as cited in the IDS, hereinafter referred to as "AIMS") in view of Shiraishi et al. USPN 5,576,829 and further in view of Oohashi et al. USPN 6,078,393 (hereinafter Oohashi).

As discussed above the combination of Ferguson, Kuwabara, and Shiraishi disclose all of the limitations of claim 23. Neither Ferguson nor Shiraishi explicitly disclose a homogenizer disposed in the vicinity of said transmission light illumination means for reducing speckle resulting from use of said light source.

Oohashi discloses that because the UV laser light outputted from the UV laser light source 20 is forced to pass through the diffusing filter 21 rotating around the optical axis of the UV laser light and reach the illumination optical system 22, the disorder of the phase of the interference light resulting from speckles caused by the stationary diffusing filter 21 can be randomized. This reduces speckles, improving the reliability with which the phase value of the phase shifter 29b can be measured with high accuracy (col. 8 lines 40-67).

Ferguson, Kuwabara, Shiraishi, and Oohashi are all analogous art because they are all from the same field of endeavor of phase mask inspection.

At the time of the invention it would have been obvious to one of ordinary skill in the art to use diffusing filter as a homogenizer to reduce the speckle. The motivation for doing so would be in order to improve the reliability with which the phase value of the phase shifter can be measured and giving high accuracy. Therefore it would have been obvious to one of ordinary skill in the art to combine Ferguson, Kuwabara, Shiraishi, and Oohashi in order to obtain the invention as specified in claim 34.

8. Claims 25-26, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ferguson et al. USPN 6,327,033 in view of Kuwabara USPN 6,580,502 in view of Ferguson et al. *Application of an Aerial Image Measurement System to Mask Fabrication and Analysis* (as cited in the IDS, hereinafter referred to as "AIMS") further in view of Shiraishi et al. USPN 5,576,829 (hereinafter "Shiraishi") and further in view of Torigoe et al. USPN 5,114,223 (hereinafter "Torigoe").

Regarding claims 25-26 Ferguson, Kuwabara, AIMS, nor Shiraishi explicitly disclose a pulsating laser light source, however it is well known in mask inspection to use a pulsating laser light source. Torigoe discloses a pulsating laser light source 1 (figure 1, col. 5 lines 5-12) in a mask exposure environment. It would have been obvious to one of ordinary skill in the art to combine Ferguson, Kuwabara, AIMS, Shiraishi, and Torigoe in order to use a pulsating laser light source since it would give a more accurate transmitted image.

Regarding claim 28, Ferguson discloses that the mask to be inspected for phase defects (700) is secured to the moveable stage of the inspection system (710).

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Contact Information


Any inquiry concerning this communication or earlier communications from the examiner should be directed to John B. Strege whose telephone number is (571) 272-7457. The examiner can normally be reached on Monday-Friday between the hours of 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta can be reached on (571) 272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2625

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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